

Red Grouper Regulatory Amendment and Interim Rule: Size Limit Analyses
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Background

During the May 9-12, 2005, Gulf of Mexico Fishery Management Council (Council) meeting in Biloxi, Mississippi, the Council received a request from the state of Florida to reconsider minimum size limit increases for the Red Grouper Regulatory Amendment. The Council had previously considered increases to the red grouper minimum size limit during their March 2005 meeting, but made a motion to eliminate them from further consideration. The purpose of this report is to evaluate reductions in harvest resulting from increases to the recreational red grouper minimum size limit. Estimated reductions for the 2005 red grouper interim rule are also provided. There is also a discussion of recreational red grouper releases and discards.

Methods

Size Limit Analysis

Intercept data from the Marine Recreational Fisheries Statistics Survey (MRFSS) and the Southeast Fisheries Science Center (SEFSC) Headboat Survey were used for size limit analyses. Intercept data for 2003-2004 were used for MRFSS analyses. Headboat data were unavailable for 2004, so intercept data for 2002-2003 were used. MRFSS length measurements were reported in cm fork length (FL) and headboat length measurements were reported in mm total length (TL). Length measurements were converted to inches TL using the following equations:

MRFSS: $TL (\text{inches}) = (1.04 \times (FL (\text{mm}) + 3.47)/25.4)$ (Lombardi-Carlson et al. 2002)
Headboat: $TL (\text{inches}) = TL (\text{mm})/25.4$

MRFSS weight measurements were recorded in kilograms whole weight (WW) and Headboat weight measurements were recorded in grams WW. Weights were converted to pounds WW using the following equations:

MRFSS: $WW (\text{lbs}) = WW (\text{kg}) \times 2.20462$
Headboat $WW (\text{lbs}) = WW (\text{grams})/453.5924$

In the MRFSS database, weights were not recorded for all red grouper intercepts. The following formula from Lombardi-Carlson et al. (2002) was used to estimate weights from length measurements: $WW (\text{lbs}) = (5.48 \times 10^{-9} \times FL (\text{mm})^{3.18}) \times 2.20462$. All weight measurements were recorded for each intercept in the Headboat database.

Reductions in harvest (both numbers and weight of fish) were calculated for each mode of fishing (charter, headboat, and private/rental) as follows using modified methods of Chih (2003):

Percent reduction = $(C - G) \times r + G \times m + G$, where:
 $m = B/C - B$ (non-compliance or measurement error)
 C = catch in either number of fish or pounds WW
 G = number or weight of fish greater than or equal to the minimum size limit
 r = release mortality (0.0, 0.1, 0.2, or 0.3)
 B = number or weight of fish smaller than 20 inches TL

Calculated reductions were then weighted using the proportion of landings from each mode of fishing to determine annual reductions for various size limits. Reductions for the 2005 red grouper interim rule were also estimated using only size limit data from July – December. Size limits in 2005 were assumed to be effective July 1, therefore no reductions from size limit changes were estimated during January-June.

Recreational Releases and Discards

Estimates of red grouper landings and releases were obtained from the MRFSS. The MRFSS classifies recreational catch into three categories:

- Type A – Fish that were caught, landed whole, and available for identification and enumeration by the interviewers.
- Type B – Fish that were caught but either not kept or not available for identification.
 - Type B1 – Fish that were caught and filleted, released dead, given away, or disposed of in some way other than Types A or B2.
 - Type B2 – Fish that were caught and released alive.

Estimates of releases (type B2) were summarized from 1981 through 2004 and the number discarded dead was estimated by applying a 10 percent discard mortality rate to all releases. The proportion of fish released and fish discard dead was then compared to the proportion of fish harvested (type A + B1).

Results

Size Limit Analysis

Tables 1 and 2 summarize the annual and 2005 percent reductions in numbers of fish resulting from various size limits and release mortality rates. Increasing the size limit by one-inch to 21 inches TL would reduce the annual number of fish harvested by 10.4-20.9 percent, depending on the release mortality rate assumed. The number of fish harvested in 2005 would be reduced by 4.4-9.6 percent if the size limit were increased one-inch. Increasing the size limit by two-inches to 22-inches TL would reduce the annual number of fish harvested by 25.3-42.2 percent and the 2005 number of fish harvested by 13.1-22.0 percent. Even greater reductions in harvest would result if the size limit were increased to 23 or 24 inches, respectively (Tables 1 and 2). A one-inch increase in the size limit would have a slightly greater reduction on headboat harvest when compared to other modes of fishing. Increasing the minimum size limit to 22-inches or greater would have slightly greater effects on charter and private mode harvest than headboat harvest.

Tables 3 and 4 summarize the annual and 2005 percent reductions in biomass (pounds) resulting from various red grouper size limits and release mortality rates. Increasing the size limit by one-inch to 21-inches TL would reduce the annual biomass of fish harvested by 7.6-14.5 percent, depending on the release mortality rate assumed. The biomass of red grouper harvested in 2005 would be reduced by 3.3-6.8 percent if the size limit were increased by one-inch. A two-inch increase in the size limit would reduce the annual biomass of fish harvested by 19.9-32.1 percent and the 2005 biomass of fish harvested by 10.5-17.1 percent. Even greater reductions in biomass would result if the size limit were increased to 23 or 24 inches, respectively (Tables 3 and 4)

Table 1. Estimated annual reductions in red grouper harvest (numbers of fish) by mode for various size limits and release mortality rates.

Size Limit	Release Mortality	Estimated Reduction			
		Charter	Private	Headboat	All Modes
21"	0%	22.9	20.2	26.5	20.9
21"	10%	19.3	16.8	21.0	17.4
21"	20%	15.6	13.4	15.4	13.9
21"	30%	11.9	10.0	9.9	10.4
22"	0%	40.8	42.6	42.2	42.2
22"	10%	35.3	36.9	35.1	36.5
22"	20%	29.9	31.3	27.9	30.9
22"	30%	24.4	25.7	20.8	25.3
23"	0%	54.0	56.0	52.2	55.5
23"	10%	47.2	49.0	44.1	48.5
23"	20%	40.4	42.1	35.9	41.6
23"	30%	33.6	35.1	27.8	34.6
24"	0%	64.0	64.4	60.5	64.2
24"	10%	56.2	56.6	51.6	56.4
24"	20%	48.4	48.8	42.6	48.5
24"	30%	40.7	41.0	33.7	40.7

Table 2. Estimated 2005 reductions in red grouper harvest (numbers of fish) by mode for various size limits and release mortality rates.

Size Limit	Release Mortality	2005 Estimated Reduction			
		Charter	Private	Headboat	All Modes
21"	0%	11.9	8.9	13.2	9.6
21"	10%	10.0	7.3	10.2	7.9
21"	20%	8.1	5.7	7.2	6.1
21"	30%	6.1	4.0	4.2	4.4
22"	0%	22.1	22.1	19.1	22.0
22"	10%	19.1	19.2	15.5	19.1
22"	20%	16.2	16.2	11.9	16.1
22"	30%	13.2	13.3	8.3	13.1
23"	0%	29.7	30.2	23.8	30.0
23"	10%	26.0	26.4	19.8	26.2
23"	20%	22.3	22.7	15.7	22.4
23"	30%	18.6	18.9	11.7	18.7
24"	0%	35.9	35.9	28.1	35.7
24"	10%	31.6	31.6	23.6	31.4
24"	20%	27.3	27.3	19.1	27.1
24"	30%	22.9	22.9	14.6	22.7

Table 3. Estimated annual reductions in red grouper harvest (pounds WW) by mode for various size limits and release mortality rates.

Size Limit	Release Mortality	Estimated Reduction			
		Charter	Private	Headboat	All Modes
21"	0%	16.5	14.0	14.7	14.5
21"	10%	14.0	11.8	12.4	12.2
21"	20%	11.5	9.5	10.0	9.9
21"	30%	9.0	7.3	7.7	7.6
22"	0%	31.4	32.2	32.2	32.1
22"	10%	27.4	28.2	28.2	28.1
22"	20%	23.4	24.1	24.0	24.0
22"	30%	19.4	20.0	19.9	19.9
23"	0%	43.9	44.8	44.8	44.6
23"	10%	38.7	39.4	39.4	39.3
23"	20%	33.4	34.1	34.0	34.0
23"	30%	28.2	28.8	28.7	28.7
24"	0%	55.0	53.7	54.1	54.0
24"	10%	48.7	47.5	47.9	47.7
24"	20%	42.3	41.3	41.6	41.5
24"	30%	36.0	35.1	35.3	35.3

Table 4. Estimated 2005 reductions in red grouper harvest (pounds WW) by mode for various size limits and release mortality rates.

Size Limit	Release Mortality	2005 Estimated Reduction			
		Charter	Private	Headboat	All Modes
21"	0%	8.5	6.3	11.1	6.8
21"	10%	7.2	5.2	8.8	5.7
21"	20%	5.9	4.1	6.4	4.5
21"	30%	4.6	3.0	4.1	3.3
22"	0%	16.8	17.2	16.8	17.1
22"	10%	14.7	15.0	14.0	14.9
22"	20%	12.6	12.8	11.1	12.7
22"	30%	10.4	10.6	8.2	10.5
23"	0%	24.0	24.6	22.3	24.5
23"	10%	21.2	21.7	18.9	21.5
23"	20%	18.3	18.8	15.4	18.6
23"	30%	15.5	15.8	12.0	15.7
24"	0%	30.8	30.8	27.5	30.7
24"	10%	27.3	27.3	23.6	27.2
24"	20%	23.8	23.7	19.6	23.6
24"	30%	20.2	20.2	15.7	20.1

Recreational Releases and Discards

The number of red grouper released annually between 1981 and 2004 ranged from 60,092 to 3,039,081 fish. Releases were highest in 1991 and 2004 (Figure 1). A large increase in the number of fish released was observed in 1990-1991, when the minimum size limit for red grouper was increased to 20-inches TL. Since 1991, the number of red grouper released has averaged 1,966,983 annually. In more recent years (2000-2004), the number of red grouper released has averaged 2,191,607 annually. The number of red grouper dying from release mortality each year since 1991, assuming a 10 percent release mortality rate, has ranged from 109,900 to 303,908 fish. Dead discards have accounted for approximately 44 percent of the total red grouper dying each year since 1991 (Figure 2).

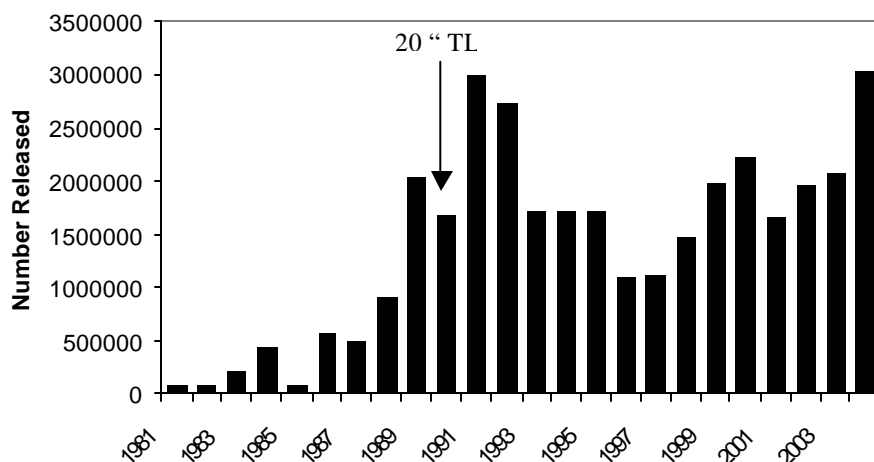


Figure 1. Estimated number of red grouper released by year, 1982-2004 (source: MRFSS)

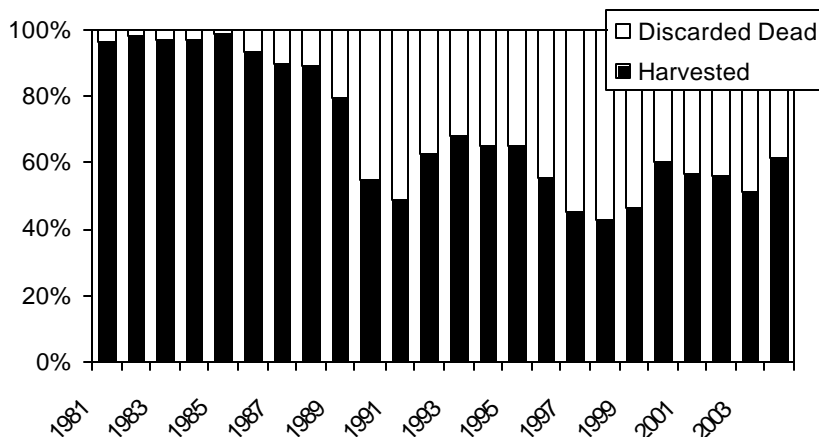


Figure 2. Proportion of red grouper harvested versus discarded dead. The proportion dying from release assumes a 10 percent release mortality rate.

Discussion

Increasing minimum size limits can decrease the number and biomass of fish harvested. However, size limit increases can also result in forgone yield from additional natural and release mortality occurring before fish recruit to the fishery. The most recent yield-per-recruit (YPR) analysis for red grouper was conducted in the 1993 stock assessment (Goodyear and Schirripa 1993). Based on the assessment, YPR is maximized at 18 inches TL assuming a 33 percent release mortality rate, 19 inches TL assuming a 20 percent release mortality rate, and 25 inches TL assuming no release mortality. The assessment did not evaluate YPR for a release mortality rate of 10 percent, which was the release mortality rate used for recreational caught fish in the last assessment (SEFSC 2002). Extrapolating from the 1993 stock assessment YPR models, YPR is likely maximized between 20 and 22 inches TL.

Based on the von Bertalanffy age-length equation used in previous assessments (Goodyear and Schirripa 1993; Schirripa et al. 1999; SEFSC 2002), average age-at-first capture is estimated to be 4.42 years at 20-inch TL, 4.84 years at 21-inches TL, 5.3 years at 22-inches TL, 5.81 years at 23-inches TL, and 6.39 years at 24-inches TL (Figure 3). Increasing the minimum size limit by 1 to 2 inches would result in an additional 5-11 months (on average) for red grouper to recruit to the fishery. A 23 or 24-inch TL size limit would result in an additional 16 to 24 months (on average) for red grouper to recruit to the fishery.

The longer the period of time to recruit to the fishery the greater the loss in yield resulting from natural and release mortality. Current estimates of discards indicate as much as 44 percent of the total mortality occurring in the recreational red grouper fishery is from release mortality. Increases to the minimum size limit would result in an even greater portion of fish dying from release and therefore unavailable for harvest.

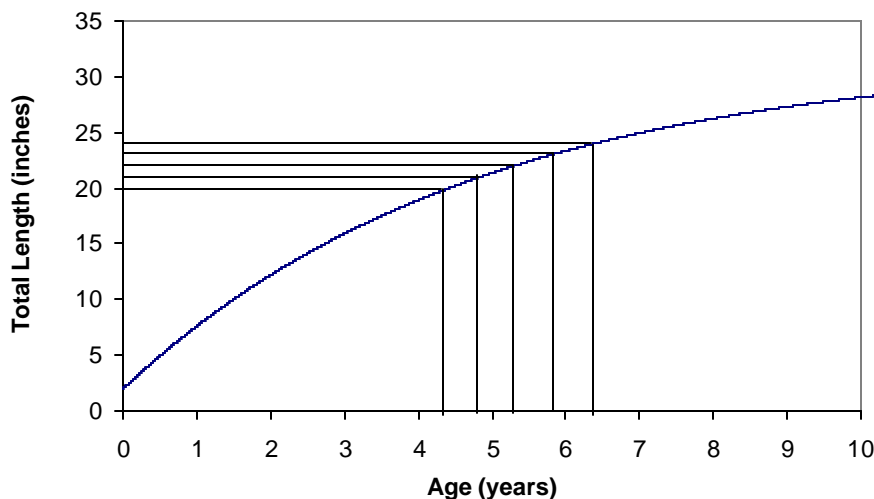


Figure 3. Von Bertalanffy age-growth curve for red grouper depicting ages for sizes ranging from 20 to 24 inches TL.

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